UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

SUBJECT: Soil Screening Levels Recalculated for use as Cleanup Performance Standards in the Foote Mineral Record of Decision.

DATE: April 10, 2006

FROM: Jim Feeney, Remedial Project Manager

TO: Foote Mineral File

During the Remedial Investigation for the Foote Mineral Co. Superfund Site (the "Site"), initial Soil Screening Levels (SSLs) were developed. SSLs are calculated soil contaminant concentrations developed using the site soil characteristics and target (safe) groundwater concentrations. The resulting SSLs are soil concentrations that would not cause contaminant levels in the underlying groundwater to exceed the target groundwater concentrations. The SSLs were revised during the Feasibility Study (FS) and presented in the FS Report.

During the development of EPA's Record of Decision for the Site, Preliminary Remediation Goals (PRGs) were developed for the contaminants in groundwater and set to be the cleanup performance standards for Site groundwater. The groundwater PRGs are presented in Table III of the ROD. The SSLs were then recalculated using the groundwater PRGs as the target groundwater concentrations. The resulting SSLs have been incorporated into the Selected Remedy and are presented in Table I of the ROD.

These revised SSLs were calculated using the equations and soil parameters on the original calculation sheets from the Feasibility Study Report which are attached to this memo. The SSLs for boron, iron and manganese were not revised from the Feasibility Study values.

Table A1-1
Screening Level in Soil - Calculation Sheet
Antimony
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	391	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 45.98

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	45.98	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	391	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.67

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	1.24E-04	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.0000116 mg/L
K_d =	45.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Antimony C_t = 0.006 mg/kg

Antimony

Using PRG (mg/L) = 0.006 Screening Level in Soil (mg/kg) = 3.10

Table A1-2
Screening Level in Soil - Calculation Sheet
Arsenic
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	118	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 13.91

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	13.91	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	118	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	4.77E-03	Target leachate Concentration (mg/L) [PRG * DAF] PRG = 0.000446 mg/L
K_d =	29.00	Soil-water partition coefficient (L/kg)
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Arsenic C_t = 0.140 mg/kg

Arsenic

Using PRG (mg/L) = 0.010 Screening Level in Soil (mg/kg) = 3.14

Table A1-3
Screening Level in Soil - Calculation Sheet
Boron
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	438	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 51.52

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	51.52	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	438	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.67

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	14.296	Target leachate Concentration (mg/L) [PRG * DAF]
K_d =	10.28	Soil-water partition coefficient (L/kg)
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

PRG = 1.34 mg/L

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Boron C_t = 150.431 mg/kg

Table A1-4
Screening Level in Soil - Calculation Sheet
Chromium (as Hexavalent)
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	591	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 69.37

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	69.37	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	591	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.66

Screening Level in Soil

C_t =		*Screening Level in Soil (mg/kg)*	
C_w =	0.064	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.006 mg/L (for Cr6+)
K_d =	19.00	Soil-water partition coefficient (L/kg) (for Cr6+)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Chromium C_t = 1.230 mg/kg

Chromium

Using PRG (mg/L) = 0.100 Screening Level in Soil (mg/kg) = 20.5

Table A1-5
Screening Level in Soil - Calculation Sheet
Fluoride
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	180	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a\{1 - e^{(-LI)/(Kida)}\}$$

d = 21.24

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	21.24	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	180	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.69

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	10.477	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.98 mg/L (for Fluoride)
K_d =	150.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Fluoride C_t = 1,574 mg/kg

Fluoride

Using PRG (mg/L) = 4.0 Screening Level in Soil (mg/kg) = 6,424

Table A1-6
Screening Level in Soil - Calculation Sheet
Iron
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	327	Source Length parallel to ground water flow (m)
d_a =	327	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 38.59

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	38.59	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	327	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		*Screening Level in Soil (mg/kg)*	
C_w =	34.886	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 3.26 mg/L
K_d =	25.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Iron C_t = 881 mg/kg

Table A1-7
Screening Level in Soil - Calculation Sheet
Lithium
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	512	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 60.08

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	60.08	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	512	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.66

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	2.772	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.26 mg/L
K_d =	6.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Lithium C_t = 17.306 mg/kg

Table A1-8
Screening Level in Soil - Calculation Sheet
Manganese
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	258	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 30.39

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	30.39	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	258	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.68

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	0.591	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.0553 mg/L
K_d =	65.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Manganese C_t = 39 mg/kg

Table A1-9
Screening Level in Soil - Calculation Sheet
Thallium
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	321	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 37.73

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	37.73	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	321	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.68

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	0.003	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.000276 mg/L
K_d =	71.00	Soil-water partition coefficient (L/kg)	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.00	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Thallium C_t = 0.210 mg/kg

Thallium

Using PRG (mg/L) = 0.0005 Screening Level in Soil (mg/kg) = 0.38

Table A1-10
Screening Level in Soil - Calculation Sheet
Benzene
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	91	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a\{1 - e^{(-LI)/(Kida)}\}$$

d = 10.70

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	10.70	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	91	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.033	Target leachate Concentration (mg/L)
		[PRG * DAF] PRG = 0.00308 mg/L
K_d =	0.16	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.22	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Benzene C_t = 0.013 mg/kg

Benzene

Using PRG (mg/L) = 0.005 Screening Level in Soil (mg/kg) = 0.021

Table A1-11
Screening Level in Soil - Calculation Sheet
Bromoform
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	111	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a\{1 - e^{(-LI)/(Kida)}\}$$

d = 13.02

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	13.02	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	111	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		*Screening Level in Soil (mg/kg)*
C_w =	0.150	Target leachate Concentration (mg/L)
		[RME * DAF] RME = 0.014 mg/L
K_d =	0.63	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.02	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Bromoform C_t = 0.131 mg/kg

Bromoform (as 100% of Total Trihalomehanes)
Using PRG (mg/L) = 0.080 Screening Level in Soil (mg/kg) = 0.748

Table A1-12
Screening Level in Soil - Calculation Sheet
Carbon Tetrachloride
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	111	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 13.02

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	13.02	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	111	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.003	Target leachate Concentration (mg/L) [PRG * DAF] PRG = 0.00032 mg/L
K_d =	0.76	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	1.05	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Carbon Tetrachloride C_t = 0.003 mg/kg

Carbon Tetrachloride
Using PRG (mg/L) = 0.005 Screening Level in Soil (mg/kg) = 0.0469

Table A1-13
Screening Level in Soil - Calculation Sheet
Chloroform
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	92	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a\{1 - e^{(-LI)/(Kida)}\}$$

d = 10.87

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	10.87	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	92	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)	
C_w =	0.002	Target leachate Concentration (mg/L) [PRG * DAF]	PRG = 0.000192 mg/L
K_d =	0.27	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005	
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})	
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})	
P =	1.64	Dry Soil Bulk Density (kg/L)	
H' =	0.13	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)	

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Chloroform C_t = 0.001 mg/kg

Chloroform (as 100% of Total Trihalomehanes)
Using PRG (mg/L) = 0.080 Screening Level in Soil (mg/kg) = 0.417

Table A1-14
Screening Level in Soil - Calculation Sheet
1,2-Dichloroethane
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	23	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a\{1 - e^{(-LI)/(Kida)}\}$$

d = 2.70

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	2.70	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	23	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.71

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.032	Target leachate Concentration (mg/L) [RME * DAF] RME = 0.003 mg/L
K_d =	0.610	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.04	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

1,2-Dichloroethane

C_t = 0.027 mg/kg

1,2-Dichloroethane
Using PRG (mg/L) = 0.005 Screening Level in Soil (mg/kg) = 0.045

Table A1-15
Screening Level in Soil - Calculation Sheet
1,2-Dichloroethene
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	30	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 3.53

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	3.53	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	30	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.239	Target leachate Concentration (mg/L) [RME * DAF] RME = 0.0223 mg/L
K_d =	0.19	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.27	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

1,2-Dichloroethene

C_t = 0.104 mg/kg

1,2-Dichloroethene

Using PRG (mg/L) = 0.070 Screening Level in Soil (mg/kg) = 0.326

Table A1-16
Screening Level in Soil - Calculation Sheet
Ethylbenzene
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	111	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 13.02

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	13.02	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	111	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.142	Target leachate Concentration (mg/L) [RME * DAF] RME = 0.0133 mg/L
K_d =	1.02	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.30	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Ethylbenzene C_t = 0.180 mg/kg

Ethylbenzene

Using PRG (mg/L) = 0.700 Screening Level in Soil (mg/kg) = 9.47

Table A1-17
Screening Level in Soil - Calculation Sheet
Tetrachloroethene
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	312	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 36.69

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	36.69	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	312	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.68

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.041	Target leachate Concentration (mg/L) [PRG * DAF] PRG = 0.00385 mg/L
K_d =	4.96	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.75	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Tetrachloroethene

C_t = 0.214 mg/kg

Tetrachloroethene (PCE)
Using PRG (mg/L) = 0.005 Screening Level in Soil (mg/kg) = 0.278

Table A1-18
Screening Level in Soil - Calculation Sheet
Trichloroethene
Cyprus Foote Mineral Site
East Whiteland Township, Pennsylvania

Mixing Zone Depth

d =		Mixing Zone Depth (m)
L =	30	Source Length parallel to ground water flow (m)
d_a =	67	Aquifer thickness (m)
I =	0.23	Infiltration Rate (m/yr)
K =	595	Hydraulic Conductivity (m/yr)
i =	0.032	Hydraulic Gradient (m/m)

Where:

$$d = (0.0112*L^2)^{0.5} + d_a \{1 - e^{(-LI)/(Kida)}\}$$

d = 3.53

Dilution Factor

DAF =		Dilution Factor (unitless)
K =	595.20	Hydraulic Conductivity (m/yr)
i =	0.03	Hydraulic Gradient (m/m)
d =	3.53	Mixing Zone Depth
I =	0.23	Infiltration Rate (m/yr)
L =	30	Source Length parallel to ground water flow (m)

Where

$$DAF = 1 + (Kid)/(IL)$$

DAF = 10.70

Screening Level in Soil

C_t =		Screening Level in Soil (mg/kg)
C_w =	0.017	Target leachate Concentration (mg/L) [PRG * DAF] PRG = 0.00155 mg/L
K_d =	0.47	Soil-water partition coefficient (L/kg) $K_d = K_{oc}f_{oc}$ Where f_{oc}=0.005
Qw =	0.398	Water Filled Porosity (L_{water}/L_{soil})
Qa =	0.007	Air filled Porosity (L_{air}/L_{soil})
P =	1.64	Dry Soil Bulk Density (kg/L)
H' =	0.43	Dimensionless Henry's Law Constant (H * 41 where 41 is a conversion factor)

Where:

$$C_t = C_w * [K_d + (Qw + QaH')/(P)]$$

Trichloroethene

C_t = 0.012 mg/kg

Trichloroethene (TCE)
Using PRG (mg/L) = 0.005 Screening Level in Soil (mg/kg) = 0.0387